

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2022/2023

EEE1036 – DIGITAL LOGIC DESIGN

(All sections / Groups)

6 OCTOBER 2023

9.00 a.m. – 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **SIX** pages including cover page with **FOUR** questions only.
2. Answer **ALL** questions and print all your answers in the answer booklet provided.
3. All questions carry equal marks and the distribution of the marks for each question is given.

Question 1

- (a)
- (i) With the aids of a diagram, differentiate digital and analog systems. [4 marks]
 - (ii) State **THREE** advantages of digital systems. [3 marks]
- (b) Perform the following operations with clear working steps:
- (i) Convert the decimal value of 213.75_{10} to binary, octal and hexadecimal numbers. [6 marks]
 - (ii) Perform BCD addition for 82_{10} and 29_{10} . [3 marks]
 - (iii) Convert the binary number of 10000111_2 into Gray code. [3 marks]
- (c) Perform the following operations in 2's complement system by using 8 bits for each number. Check your results by converting the binary result to decimal.
- (i) Subtract -43 from +76 [3 marks]
 - (ii) Add +55 to -25 [3 marks]

Continued...

Question 2

(a) Simplify the given expression below to a SOP form using Boolean theorems:

(i) $Y = ABC\overline{D} + AB\overline{C} + ABC\overline{D} + \overline{(\overline{A} + \overline{B} + C + D)}$ [4 marks]

(ii) $Y = A(B + A\overline{C}) + (\overline{A} + C)(B + C)$ [5 marks]

(b) Given the following expression,

$$f(A,B,C,D) = \Sigma m(0, 1, 4, 10, 11, 12) + d(2, 6, 8)$$

- (i) Form the truth table of the above expression. [4 marks]
(ii) Simplify the above expression to a SOP form using Karnaugh Map. [9 marks]
(iii) State two reasons why Karnaugh Map simplification is better than Quine-McCluskey tabulation technique. [3 marks]

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Question 3

(a) Figure Q3(a) shows a typical JK flip-flop.

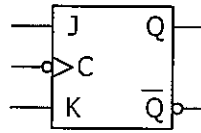


Figure 3(a)

- (i) Construct the excitation table for the JK flip-flop. [3 marks]
 - (ii) Based on the excitation table constructed in Figure 3(a), determine the JK flip-flop transition table. [4 marks]
 - (iii) Show the conversion of positive edge-triggered D flip flop to JK flip flops and draw logic diagram using additional logic gates. [6 marks]
- (b) Briefly describe what a shift register is. State its **TWO** basic functions. [4 marks]
- (c) For the data input and clock in Figure 3(c)(i), determine the states of each flip-flop in the shift register for the diagram and show the Q waveforms. Assume that the register contains all 1s initially. Redraw the input signal and sketch the corresponding output signals, Q_0 , Q_1 , Q_2 and Q_3 based on the given serial data input and CLK in Figure 3c(ii). [8 marks]

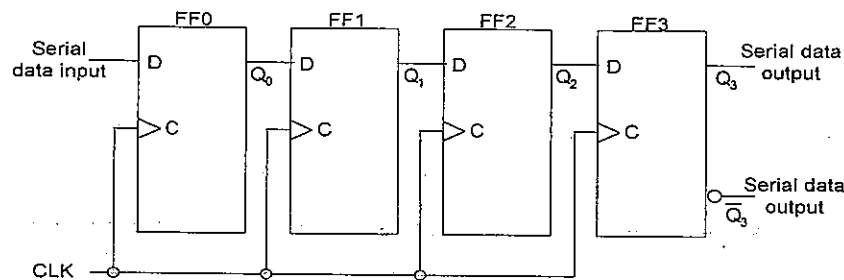


Figure 3(c)(i)

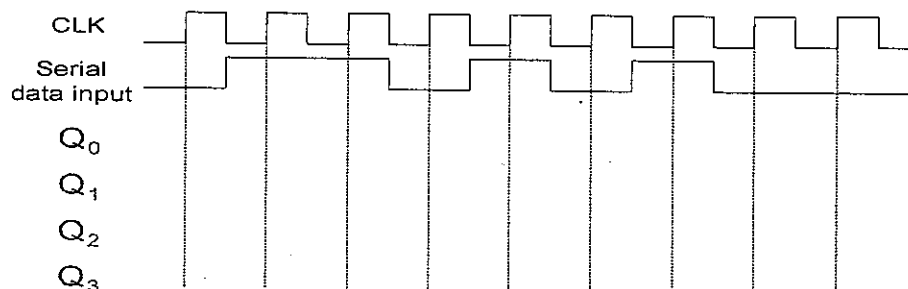


Figure 3(c)(ii)

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Question 4

- (a) Implement the function $f(a, b, c) = \prod M(1, 4, 5, 6)$ using
- (i) Active-low output implementation of 3-to-8 decoders. [5 marks]
 - (ii) Active-high outputs implementation of 3-to-8 decoders. [5 marks]
- (b) Draw a schematic diagram of a 3-bit ripple-carry adder, showing how it is made of 1-bit full adders. [5 marks]
- (c) With the aid of a schematic diagram, suggest a way to connect 8 sensors with binary output to one input port, such that the sensors' state can be read via the input port. [5 marks]
- (d) Implement switching function $f(x, y, z) = \sum m(1, 2, 3, 4, 5, 6)$ using 3-to-8 decoder with active low outputs (draw the schematic diagram). Let x be the most significant bit and z be the least significant bit. [5 marks]

Continued...

APPENDIX**Selected Laws of Boolean Algebra**

1. Commutative Law
 - (a) $A + B = B + A$
 - (b) $AB = BA$
2. Associate Law
 - (a) $(A + B) + C = A + (B + C)$
 - (b) $(AB)C = A(BC)$
3. Distributive Law
 - (a) $A(B + C) = AB + AC$
 - (b) $A + (BC) = (A + B)(A + C)$
4. Identity Law
 - (a) $A + A = A$
 - (b) $AA = A$
5.
 - (a) $A\bar{B} + A\bar{\bar{B}} = A$
 - (b) $(A + \bar{B})(A + \bar{\bar{B}}) = A$
6. Redundance Law
 - (a) $A + A\bar{B} = A$
 - (b) $A(A + B) = A$
7.
 - (a) $0 + A = A$
 - (b) $0A = 0$
8.
 - (a) $1 + A = 1$
 - (b) $1A = A$
9.
 - (a) $\bar{\bar{A}} + A = 1$
 - (b) $\bar{\bar{A}} A = 0$
10.
 - (a) $A + \bar{\bar{A}}\bar{B} = A + \bar{B}$
 - (b) $A(\bar{\bar{A}} + \bar{B}) = A\bar{B}$
11. Double Complement Law
 - (a) $\bar{\bar{A}} = A$
12. De Morgan's Theorem
 - (a) $\overline{(A + B)} = \bar{A}\bar{B}$
 - (b) $\overline{(AB)} = \bar{A} + \bar{B}$

End of Paper